Ecological and historical correlates to the biogeography of *Cacajao*. A. BARNETT, Department of Life Sciences, University of Surrey, Roehampton, UK and S.M. LEHMAN, Department of Anthropology, SUNY-Stony Brook, Stony Brook, NY 11794.

The genus *Cacajao* (uacaris) has two species (*Cacajao calvus* and *Cacajao melanocephalus*)that have been further subdivided into 6 subspecies. Each subspecies is restricted to the Amazon basin, where the uacaris spend all or most of the year in seasonally flooded riparian forest (*igapo* and *varzea*). As specialist predators of unripe hard tree fruits, uacaris may migrate to adjacent non-flooded (*terra firme*) forest in times of fruit scarcity in the riparian zone. Although recent discoveries have substantially altered the classic distributional patterns assigned to the genus by Hershkovitz (1987), the 6 sub-species are oddly scattered through western Amazonia. Using new field data on *Cacajao* geographic distribution and habitat use, we analysed the influence of ecological and historical factors on the biogeography of this rare and unique primate. Predictions from Pleistocene refugia theory, the riverine barrier hypothesis and vicarience models were tested using a GIS system. Cladistic biogeography analyses were also run using detailed distribution data for 51 species of South American primates. *Cacajao* distribution was compared with those of riparian and terra firme specialists of Amazonian mammals, birds, frogs, lizards and fish and 20 families of plant (including *Cacajao* food and non-food families). The present-day biogeography of uacaris shows parallels to that of other medium to large body sized platyrrhines. However, no one ecological or historical factor, such as rivers, appears to be solely influencing uacari biogeography.

Is the practice of the siesta an adaptation to disease? T.L. BARONE, Sociology/Anthropology, University of Nebraska at Omaha, NE 68182.

Why does the practice of the siesta (or habitual afternoon napping) vary across human cultures? Research in human biology suggests that napping is an integral part of the sleep-wake cycle with a predisposition to sleep occurring in the afternoon and at night. Explanations for the siesta have centered on heat and/or physically demanding agricultural labor. In these explanations, it was hypothesized that the siesta functioned as a form of energy conservation. Disease creates another situation where energy conservation might be beneficial. The influence of disease on siesta patterns has not previously been examined.

A preliminary study examined the occurrence of the siesta in the Probability Sample File (PSF) from the Human Relation Area Files Collection of Ethnography (HRAF). The study had two objectives: 1) to establish the frequency of the siesta in human cultures and 2) to determine the characteristics that are necessary and sufficient for the siesta to occur.

In the results of the study, the siesta was reported in 58% of the PSF cultures. Practice of the siesta within cultures varied little by age or social status. However, in 31% of practicing cultures only males participated.

The practice of the siesta was not statistically associated with high diurnal temperatures or agricultural subsistence patterns ($p>.05$). Seasonal variation in the practice of the siesta did not occur in the majority of cultures (83%).

However, there appears to be an association between the occurrence of the siesta and the presence of infectious and parasitic disease, particularly intestinal parasites and malaria ($p<.05$).

Preliminary results suggest that the siesta could be an adaptive behavior in situations of endemic infectious or parasitic disease. The benefits of siestas may include: 1) A lowered daily energy requirement; 2) a decrease in time between periods of tissue repair and regeneration; and 3) an overall increase in time devoted to these activities during a twenty-four hour period.

Range size and territoriality among white-handed gibbons (Hylobates lar) in Khao Yai National Park, Thailand. T.Q. BARTLETT, Department of Anthropology, Dickinson College, Carlisle, PA 17013.

Discussions of primate territoriality typically focus on one of two purported functions: resource defense or mate defense. Gibbons are often a favorite subject because territoriality in this primate family is well documented. However, the relationship between territorial activity and resource availability in gibbons has not been described.

From January 1994 to January 1995 the feeding ecology of two habituated gibbon social groups was studied as part of continuing research on white-handed gibbons (Hylobates lar) in Khao Yai National Park, Thailand. Observations were conducted in a seasonally dry, monsoon forest. Gibbon range use and territorial activity (including vocal duets) were recorded during 5 day samples each month.

A distinction is drawn between home range, territory, and area of exclusive use. Home range size was determined by calculating the area of a minimum convex polygon encompassing the cumulative day ranges of each group. Home range size for the two groups were 25.4 and 21.4 ha. On average, territory size and exclusive area were 83% and 72% of home range size, respectively.

Khao Yai gibbons sing duets 1.4 times/day and engage in territorial encounters 0.8 times/day. Both behaviors show considerable variation over the course of the year, with peaks in activity during the hot season when resources are most abundant. The significance of these finding to the theory of resource defense territoriality are considered.

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Hemoglobin concentration of Ethiopians at 3530m. **C. M. BEALL, M. J. DECKER, K. P. STROHL, I. KUSHNER, Anthropology, Anatomy, and Medicine, Case Western Reserve University, Cleveland, OH 44106, G. M. BRITTENHAM, Pediatrics, Columbia University, New York, NY 10032, L. A. ALMASY, J. BLANGERO, Genetics, Southwest Foundation for Biomedical Research, San Antonio, TX 78245, A. GEBREMEDHIN, Medicine, Addis Ababa University, Addis Ababa, ETH.**

Hemoglobin concentration and hematocrit are commonly studied as measures of adaptation to high-altitude hypoxia. A higher mean hemoglobin concentration has been found among indigenous populations of the Andean Plateau than among those on the Tibetan Plateau and illustrates that the same ambient hypoxia can result in quantitatively different responses (roughly 1.4 gm/dL at 3,000-4,000m). Those findings raise the question of the response to hypoxia of the high-altitude native population of the Semien Plateau of East Africa. This report presents the results of a field survey of hemoglobin concentration of 313 Ethiopians from 14 to 86 years of age, native residents of a traditional rural community at 3530m (11,650').

After exclusion for poor health, pregnancy and recent childbirth, data from 285 people were available for analysis. Measures of iron sufficiency (plasma ferritin, free erythrocyte protoporphyrin and transferrin receptor concentration) were obtained for 249 people; 246 had normal values of all three indicators. The average hemoglobin concentration of males was 15.9 $\pm$ 1.3 (SD) gm/dL (n=131) and of females was 15.0 $\pm$ 1.1 (n=115) gm/dL. This Ethiopian sample resembles samples from Tibetans living at comparable altitudes in that hemoglobin concentrations differ little from U.S. sea level values. However, high-altitude native Tibetans have low oxygen saturation of hemoglobin relative to sea level while the Ethiopian mean oxygen saturation of hemoglobin of 95.5 $\pm$ 1.6% (n=263) resembles U. S. sea level values. Ethiopians may have unique adaptations of oxygen uptake or affinity that result in a lack of an hypoxic stimulus to erythropoiesis despite their high-altitude residence. These findings suggest the Ethiopians may have a pattern of adaptation to high-altitude hypoxia that differs from both the Andean and the Tibetan patterns.

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Knuckle-walking and the origin of human bipedalism. **D.R. BEGUN, University of Toronto, Toronto, ON, M5S 3G3, Canada.**

Functional analysis of fossil great apes and humans indicate that no known fossil taxon was a habitual knuckle-walker. However, the phylogenetic relations among hominoids suggests that the last common ancestor of African apes and humans was in fact a knuckle-walker. Anatomical, fossil and molecular evidence of relations among the Hominoidea strongly suggest that Pan and Homo share a common ancestor not shared by any other living taxon. If this is correct, then knuckle-walking must have evolved once in the common ancestor of Pan, Gorilla and Homo (in which it was lost), or twice, independently in each African ape lineage. In addition to being less parsimonious, most multiple origins hypotheses for knuckle-walking also fail to account for characters shared by African apes and humans that are plausibly functionally related to increased terrestriality. These include vertebral, limb and intra-limb proportions, and limb long bone, carpal, tarsal, metapodial, and phalangeal morphology. In theory, knuckle-walking and obligate bipedalism could have evolved from an unknown type of terrestrial quadrupedalism, possibly associated with high frequencies of facultative bipedality. This would also account for characters and positional behavior shared by African apes and humans, the differences between Pan and Gorilla, and the apparent retention of primitive features of the trunk in humans. However, it implies a substantial increase in homoplasy as well as a hypothetical ancestral morphotype unknown in any in group or out group. Functional anatomy and phylogeny together continue to suggest that humans are most likely to have evolved from a knuckle-walker. However, a functionally plausible, though less parsimonious facultative bipedality hypothesis is also possible. In this regard, hints of the unique functional morphology of Ardipithecus ramidus suggest that this taxon would serve to test these two alternatives.

This work supported by grants from NSERC and Wenner-Gren.

Negative Correlations among Brain Case Measurements in *Macaca mulatta* and their possible Explanations. **B. BEHRENS, University of New Mexico, Albuquerque, NM, 87131.**

Unless one uses angles and ratios, positive correlations are the norm in morphological measurements. They are explained with overall growth and functional and developmental interactions. However, there are circumstances where negative correlations can be expected: 1) Between two variables sharing a landmark (geometry). If the angle α between the two variables is larger than 90 degrees, the expected correlation, $0.5*\cos(\alpha)$, is negative. 2) Between two redundant variables (compensation).

This study presents results from brain case measurements taken on a cross-sectional growth series of *Macaca mulatta* (CPRC, Cayo Santiago collection). Data consisted of log-transformed cranial arcs and cords. In adults and subadults (three years and older), longitudinal arcs of neighboring cranial bones (frontal and parietal, parietal and occipital) are significantly negatively correlated, non-neighboring bones (frontal and occipital) are not significantly correlated. Cranial cords show a very similar pattern. Individuals under three years of age show low positive correlations; if the effect of age is removed through partial correlation the adult pattern, though not significant, emerges. Based on the geometry of frontal and parietal, a strong negative correlation between frontal and parietal arcs or chords is expected. Likewise, the consistent relation between lambda and brain surface anatomy, but not between bregma and brain surface anatomy, suggests that frontal and parietal longitudinal dimensions are in a compensatory relationship and should be negatively correlated. Based on the geometry of parietal and occipital bones, a strong negative correlation between their arcs or chords is unexpected. A review of suture biology points to growth processes, such as uneven growth at opposing sides of a suture, and resorption at opisthion, that can lead to these morphological patterns.

The morphology and survival of the mineralised osteocyte remnant. L.S. BELL, Dept. Palaeontology, The Natural History Museum (NHM), Cromwell Rd., London SW7 5BD, C. JONES, Dept. Mineralogy, NHM, S.Y.ALI, Dept. Experimental Pathology, Institute of Orthopaedics, UCL, Royal National Orthopaedic Hospital Trust, Stanmore HA7 4LP and P.A. ANDREWS, Dept. Palaeontology, NHM

The mineralised osteocyte remnant (MOR) represents an enigmatic type of in vivo cell death whereby the osteocyte (one of the three bone cells) mineralises in situ of its lacunar and has, only recently, been identified in the archaeological record (Bell, 1996). It is not understood why and how the osteocyte mineralises, but previous workers have connected increasing bone age and avascular bone necrosis as potential causative co-factors. Given that this mineralised cell survives into the archaeological record, it's principal value for archaeology and palaeontology must be as a potential site of DNA preservation within bone. However, that it exists at all makes it an important biological phenomenon, particularly with regard to this unusual form of apoptosis. A broad investigative study of the MOR is ongoing, and the morphological and elemental results are presented here.

The results from the morphological studies were unexpected and compelling. The study confirmed and extended Boyde's (1986) morphological observations. Further characterisation using an SEM in backscattered and secondary electron modes has detailed internal structures in more detail, and revealed that the MOR, whether post operative or archaeological, contain commonly, an internal branching array, with diameters of 18-20 nms, as well as electron dense globulations. The outer band of the MOR is mineral laminated with osteocyte canaliculae connecting across this mineral boundary. This suggests that the remnant cell is held within the mineral laminated structure and that this structure was in place at the point of cell death. The size and the organisation of the branching network and large globulations suggest that the cell's cytoskeleton is partially preserved, and the electron dense globulations may be condensed chromatin, remnant organelles or even lipid bodies. The time-line study produced a MOR surviving 200,000 years BP with the identical branching morphology. The electron microprobe study of the MOR gave elemental profiles virtually identical between post operative and archaeological bone. The TEM study has confirmed the SEM work and excluded the possibility that the MOR's branching structure is simply collagen. The MOR's morphology and preservation into the fossil record is remarkable and may indeed contain DNA, along with other cellular proteins.

This work was supported by the Wellcome Trust.

Large Human Panels for the Study of Genomic Variation. P. K. BENDER, L. H. TOJI, C.M. BEISWANGER, J. C. LEONARD, J. C. BECK, R. T. JOHNSON, Coriell Institute for Medical Research, Camden, NJ 08103

The Coriell Cell Repositories have compiled panels of cell lines and DNA samples from 90 donors representing 9 different ethnic origins or geographic regions, including Northern European, Chinese, Japanese, African American, Puerto Rican, Mexican, Middle Eastern, Indo-Pakistani and Southwestern American Indian. These panels of 10 individuals each have stimulated considerable research interest and requests for additional and larger panels of Caucasians and African Americans. Panels of 50 and 100 samples from African Americans have been assembled, and similar size panels of Caucasians will be available shortly. The African American samples were collected principally from the Northeastern United States. The samples are from unrelated individuals and most of the samples are from clinically unaffected donors. Approximately 80% of the samples are female. Based on the geographic data, it is estimated that the European genetic contribution to these African American panels may range between 14-20% (Parra, E.J., *et al., Am. J. Hum. Genet.*, **63**, 1839-1851, 1998). These data assure that these panels will provide a good control cohort for many linkage studies.

As part of the Repositories' routine quality assurance, each sample has been genotyped with six different microsatellites. This procedure assures sample identity from receipt of sample to shipping. As an introduction to the variation present in these panels, the allele frequencies for these six microsatellites have been determined and are available as histograms. These data allow comparison of the occurrence of low frequency alleles in the different size panels, and provide a basis for comparing representation between the different size panels. The availability of these panels provides a new and extended resource for the identification of polymorphisms that contribute to genetic variation, disease linkage, and anthropological studies.

New perspectives on the taxonomy and phylogeny of large-bodied hominoids from the middle Miocene of Kenya. B.R. BENEFIT and M.L. McCROSSIN, Southern Illinois University, Carbondale, IL 62901

Important samples of two large-bodied hominoid genera have recently been recovered from the middle Miocene of Kenya: *Kenyapithecus* from Maboko Island (McCrossin and Benefit, 1993, 1994, 1997; McCrossin et al., 1998), and *Nacholapithecus* from Baragoi (Nakatsukasa et al., 1998; Ishida et al., 1999).

Excavations at Maboko Island (1987-97) resulted in the discovery of 270 dentognathic and 38 postcranial elements (including the shoulder, arm, elbow, wrist, hand, hip, thigh, knee, ankle, and foot). These discoveries strongly support the congeneric status of *K. wickeri* and *K. africanus*. Quantitative analysis of maxillary and dental features shows that differences between KNM-FT 46 (*K. wickeri*) and BMNH M 16649 (*K. africanus*) are comparable to levels of intrageneric (and in some cases intraspecific) variation documented for living catarrhines (McCrossin, 1994; McCrossin & Benefit, 1997). *Kenyapithecus* species share derived features including proclination of the mandibular symphysis, penetration of molar roots almost to the inferior margin of a robust and shallow mandibular corpus, and strong posterior orientation of the medial epicondyle of the humerus (McCrossin and Benefit, 1993, 1997). *Nacholapithecus*, in contrast, exhibits a more vertical symphysis, molar roots restricted to the alveolar portion of a gracile and tall corpus, and more medially directed entepicondyle. Membership in the African ape and human clade is indicated for *Kenyapithecus* by the morphology of the dp_3 and postcranial remains and for *Nacholapithecus* by a subnasal pattern that includes a small incisive foramen and overlap of the nasoalveolar clivus over the palatal process. Based on misidentification of the maxillary sinus and anterior dentition and ignorance of variation in living primates, as well as on combination of the Maboko and Nachola samples, Ward et al. (1999) have suggested a new generic name for the large-bodied hominoid from Maboko and included in this taxon a sample from Kipsaramon. With BMNH M 16649 as its type specimen, *Equatorius* is a junior synonym of *Kenyapithecus africanus* (Le Gros Clark & Leakey, 1950).

A Medieval Mass Grave from Denmark (1300-1350 AD). PIA BENNIKE, Lab. of Biol. Anthrop., Univ. of Copenhagen, Blegdamsvej 3, DK-2200 Copenhagen N, Denmark.

A mass grave near Næstved with 60 skeletons has recently been excavated in Denmark. Most of the skeletons were covered with numerous injuries. As there were no skeletons of women and children, the mass grave probably contained the victims of a battle. Except for a few belt buckles, no personal items were found, indicating that the men may have been totally stripped before they were thrown into the grave.

A photogrammetric documentation during the excavation of the 12 m^2 and 1,5 m deep grave made it possible to distinguish the bones of the single skeletons later.

The new mass grave near Næstved is comparable with the well known mass graves from the battle of Visby on Gotland, Sweden in 1361 AD between Denmark and Sweden. Together the graves contained at least 1200 skeletons and are still unique. However the number of injuries on the Næstved skeletons were on average three times more frequent than the average at Visby.

The mass grave at Næstved poses a number of questions: When did the battle take place? Which historical event are the skeletons from and which weapons or protection were used? Who were the victims? Three ^{14}C analyses showed an average dating to around 1300 AD, but a possible reservoir-effect could push the dating to c. 1350. Two historical events come to the mind. One is a battle shortly before 1300 between the Danish nobleman Marsk Stig Hvide Andersen and his men on one side and the king's men or local men from Næstved on the other. It is, however, not know which of them ended in the mass grave. Another battle in Næstved took place around 1359 between the king and the noblemen from Holsten (Germany).

The many injuries on the 60 skulls from Næstved did not show a clear right/left difference in distribution as did the skulls from Visby. It is therefore an open question whether the type of fight in Næstved was the same as in Visby. The pattern of frequent left-side injuries on the Visby skulls has been interpreted as the result of attack by right-handed victors in face to face battle. The numerous injuries on single skulls from Næstved may indicate that the skeletons were victims of an ambush or a massacre.

Fecal Cortisol and Testosterone in Relation to Ancestry and Behavior in Hybrid Male Baboons. T. J. BERGMAN, Biology, Washington University, St. Louis, MO 63130, P. L. WHITTEN, Emory University, Atlanta, GA 30322

Hamadryas male baboons continuously herd 'their' females into permanent One-Male Units (OMUs), while anubis males are almost exclusively interested in estrous females with which they form temporary relationships. These two forms hybridize in the Awash National Park of Ethiopia. The group in the center of the hybrid zone consists of males which represent both a phenotypic and behavioral range from anubis-like to hamadryas-like. In this study we investigate how ancestry and mating behavior influence fecal cortisol (C) and testosterone (T) levels for these males. 126 samples were collected for 10 males over a 1 year period (7 to 20 samples per male). Samples were collected for males with estrous females (in consort) and not with estrous females (baseline). Several interesting results were found. 1) Mating behavior correlates more strongly with baseline C&T levels then does ancestry. Males who spend more time with non-estrous females (a hamadryas behavior) have higher baseline C&T levels. 2) C&T levels for males in consort are higher, on average, than baseline levels. 3) The increase over baseline C&T levels when in consort is correlated with mating behavior but not with ancestry. Males who spend more time with non-estrous females have a smaller increase in C&T levels when in consort.

Together the results indicate that animals with OMUs

appear to be, hormonally, in a permanent consortship. In addition, the stronger correlation of hormone levels with behavior (rather than ancestry) is consistent with a chain of causation flowing from ancestry to behavior to C&T levels but not from ancestry to C&T levels to behavior. These points suggest that the first step in the divergence of anubis and hamadryas social structure was a change in the amount of interest males have in non-estrous females.

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Functional diagnostics of the australopithecine foot: An architectural perspective. G. BERILLON, Institut de Paléontologie Humaine, Paris, France.

The foot as a contact area to the ground is of great interest for the understanding of early hominid locomotor abilities. From the first discovery of a fossil australopithecine foot talus (TM1517 at Kromdraai site in the 30's by Broom), to the Stw573 foot discovered by Clarke in the Sterkfontein archaeological material in 1994 and 1997, the australopithecine foot function continues to elicit controversy in the literature. Moreover, an architectural perspective has been neglected because of the fragmentary nature of foot remains.

This analysis contributes to the functional diagnostics of the australopithecine foot, focusing on the architecture. The architecture is assessed by examining proximodistal relationships, and by measuring angulations taken on the dislocated tarsometatarsal skeleton.

Australopithecine tarsal and metatarsal bones from Hadar and Omo (Ethiopia), Koobi Fora (Kenya) and Kromdraai (South Africa), are compared to a sample of Miocene hominoids from Rusinga and Songhor (Kenya), early *Homo* from Olduvai (Tanzania), Koobi Fora, Ileret and Baringo (Kenya), Neandertals, early *H. sapiens* and extant species (43 *Homo*, 36 *Pan* et 38 *Gorilla*).

The architectural analysis of the *Australopithecus afarensis* hallucal tarsometatarsal complex suggests that the hallux was slightly abducted and points to some affinities with the *Proconsul* pattern. In *A. afarensis*, the foot is flat in neutral position, ressembling the extant african great apes. Thus, it is different from the arched feet of later hominids.

Although foot remains are rare to propose complete architectural patterns, architectural data strongly corroborate the originality of the *A. afarensis* foot in which a unique pattern of abducted hallux and no plantar vault in neutral position are associated.

This work was supported by the CNRS, France.

New dental age standards for baboons (*Papio hamadryas anubis*) and mangabeys (*Cercocebus atys*) R.M. BERNSTEIN, K. ROWAN, S.R. LEIGH. Department of Anthropology, University of Illinois, Urbana.

Age standards are crucial for comparisons of ontogeny within and among species. This study enhances the applicability of dental age standards for baboons and mangabeys through regression analyses of dental eruption patterns. These standards enable the assessment of several evolutionary questions regarding intra- and inter-specific variation in dental development.

Eruption stages from longitudinal samples of known-age captive animals are used (baboons, N=158 observations; mangabeys, N=93 observations). Dental eruption was recorded based on visual examination, with teeth at the occlusal plane considered to be fully erupted. Regressions for categorical data (0=unerupted, 1=erupted) were applied to these data in order to develop age prediction formulae.

These dental age standards are effective in predicting chronological age of individuals until about 80 months of age. Standards are roughly interchangeable among species, but not between sexes. Intraspecific variability characterizes eruption ages for I1, I2, and M3. The overall pattern of dental eruption in these taxa thus appears to be conserved, especially time of M1 development. In general, baboons seem to be on an extended trajectory of dental eruption relative to mangabeys. Finally, bimaturism is evident in the eruption of the third molars and canine complex.

These results suggest that standards can be applied across papioninans, particularly early in ontogeny. This finding has important implications for comparative analyses based on wild-shot specimens and fossils of unknown chronological age. These results are evaluated in view of current life history and sexual selection theories. Specifically, we assess the significance of covariation among dental, cranio-facial and brain variables.

This research was supported by NSF (SBR 9707361) and the University of Illinois.

The use of social and ecological information in primate foraging decisions. **J.C. BICCA-MARQUES and P.A. GARBER, Department of Anthropology, University of Illinois, Urbana, IL 61801.**

A major consequence of group living is that foragers may rely on both ecological information and social information to locate feeding sites. However, although conspecifics can provide cues as to the spatial location of food patches, individual foraging decisions also must include some assessment of the likelihood of obtaining access to a resource also sought by other group members. Within groups of social foragers, some individuals are best

described as producers and actively search for food, whereas other individuals are scroungers and monitor the activities of producers in order to obtain a reward. In this paper we examine the foraging strategies of free-ranging emperor (*Saguinus imperator*) and saddleback (*S. fuscicollis*) tamarins, and identify differences in the manner in which individual group members use spatial, sensory, and social information in making within-patch foraging decisions.

An experimental field study of cognitive aspects of foraging was conducted on 4 social groups of wild tamarins at the Parque Zoobotânico, a 100 ha protected research facility administered by the Federal University of Acre, Brazil. Our research design included the construction of 4 feeding stations located in the home range of the study groups. Each feeding station consisted of 8 visually identical feeding platforms located in a circular arrangement. In all test settings, 2 platforms at each feeding station contained a food reward (banana) and the remaining 6 platforms contained a sham reward. Data are presented on 11,884 visits to these platforms by individually marked tamarins.

Results indicate that individual group members applied different behavioral strategies to solve foraging problems. In each study group, 1-2 individuals were responsible for initiating 50-75% of all food searches. Among adult emperor tamarins, social rank had a significant effect on foraging. Regardless of sex, dominants adopted a scrounger strategy whereas subordinates adopted a producer strategy. In contrast, there was no consistent relationship between social rank and foraging strategies in saddleback tamarins. This may reflect greater social tolerance during feeding. In both species there was no evidence of cognitive differences in the ability of individuals to use visual, spatial, or associative landmark cues to locate baited feeding sites. The implications of these data for the understanding of the evolution of higher cognitive skills in primates are discussed. Supported by funds from FBPN, WWF-Brasil, Wenner-Gren, ASP, CLACS/UIUC, and CAPES.

Political economy of mortality of enslaved Africans.
M.L. BLAKEY, M.E. MACK, E.G. MEDFORD, S.D. WILSON, and A. HANKIN. Howard University, Box 987, Washington, DC 20059

New York's African Burial Ground is an 18th century cemetery for enslaved Africans. The excavated archaeological population consisting of more than 400 human skeletons has undergone extensive interdisciplinary research, the mortality data from which are reported, here.

Age at death was determined using 11 skeletal aging methods where possible. Sex determinations are based on a maximum of 35 separate anatomical observations. Only adequately complete and definitely aged and sexed individuals are considered for this analysis. Age ranges were determined, and the mean years of age at death are used for analytical convenience. Mortality in the New York African archaeological population is compared with our data from church records on English burials in colonial New York City.

Men and women (16 years of age and older) show some distinctive patterns of age-specific mortality with peak mortality occurring at 30-34.9 years of age in women and 45-49.9 years of age in men. The mortality curve for females is uniquely bimodal and shows that women who survive to 45 years of age have an increased chance of living into old age. Historical data show that Africans over 50 years of age were considered to be of little economic value and were often abandoned to the streets, but the condition of older women was somehow different from that of men. English men and women are surviving into their 6th-8th decades of life in comparatively large numbers.

African men and women show an initial peak of mortality at 16-25 years of age consistent with the ages of most newly enslaved people in New York. Unlike English women, mortality in the 16-20 year old African females is pronounced due to a host of new societal and biological health risk factors.

New ear region of *Ignacius graybullianus*.
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A new skull of *Ignacius graybullianus* has been discovered in a freshwater limestone of early Eocene age (Wa-1) in the Willwood formation of the Clarks Fork Basin of northwestern Wyoming. Exceptional preservation of certain aspects of the cranial morphology help to clarify previously controversial interpretations of the composition of the auditory bulla, and add new information to our understanding of the ear region in this paromomyid plesiadapiform. The specimen includes a petrosal region that has separated along clearly-demarcated sutural lines from the rest of the skull, including the auditory bulla. This confirms the observation of Kay et al. (1990, 1992) that this supposed primate did not have a petrosal bulla. Better preservation of the lateral portion of the petrosal allows the identification of features not present in the specimen discussed by Kay et al.. Particularly, there is a distinct groove lateral to the longitudinal bony septum that may have held the internal carotid nerves or even a small promontory artery. There is no indication of a groove for a stapedial artery, indicating that this species shares a reduced internal carotid artery with *Cynocephalus* and *Plesiadapis*. The presence of a remnant of an internal carotid contrasts, however, with the condition in modern dermopterans. The very lateral position of the groove also differs from the more medial course of the internal carotid nerves in *Cynocephalus* (see Wible, 1993). A fragment of a narrow ectotympanic ring is preserved below the epitympanic recess, suggesting that the ectotympanic was more *Plesiadapis*-like than indicated by Kay et al.. In sum, this specimen confirms that *Ignacius* has some important differences from modern primates, and is less similar to modern dermopterans than previously supposed.
Supported by NSF, Wenner-Gren, Sigma-Xi, and the Paleobiological fund.

Economic, cultural, and demographic factors affecting children's growth and development in the Okavango Delta, Botswana. J. BOCK and S.E. JOHNSON, Dept. of Anthropology, University of New Mexico, Albuquerque, NM 87131.

Changes in patterns of children's activities due to economic development and related alterations in sociocultural institutions and the family can have important effects on children's growth and development. In this study we compare children's growth and physical development in two communities in the Okavango Delta of Botswana. In the first community people are engaged in traditional economic pursuits of foraging and small-scale agropastoralism with very limited integration into the cash economy and national level social, political and economic institutions. The second community is well integrated into the cash economy and national institutions. Few children in the traditional community attend school and spend most of their time in productive activities or in skill development essential to performing traditional economic activities. Most children in the wage labor community attend school and few children are engaged in traditional pursuits.

To examine the effects of this variation in children's activities on growth we used longitudinal height and weight data collected annually from 1996 to 1999 to calculate Body Mass Index (BMI) for 204 children in the traditional community and 151 children in the wage labor community ages 2 to 18. In order to determine the impact on physical development we collected one measure of strength (hemisphere dominant arm pull) and four measures of motor performance (50 meter dash, throw for distance, throw for accuracy, and head carry). These data were collected simultaneously with the anthropometric data.

Weight for height Z-scores show that children in the traditional community show slight wasting. Comparison of BMI shows that both boys and girls from the traditional community were significantly leaner than those of the same age in the wage labor community. Analysis of the physical development data reveal that, controlling for body size, both boys and girls from the traditional community had better motor performance than those of the same age in the wage labor community.

This indicates that children in the traditional community experience acute food shortages, but their physical activity results in higher scores in strength and motor performance.

Object manipulation and tool use among brown capuchins in Suriname. S. Boinski, Anthropology and Comparative Medicine, University of Florida, Gainesville, FL 32611

In recent years, the manipulative skills of capuchins, the New World primate genus *Cebus*, have garnered increased attention. Not only does the proclivity of capuchins to use tools surpass that of all other monkeys either in the Old or New World, but in many respects the manipulative abilities and dexterity of capuchins equals or betters that of the chimpanzee. Nevertheless, captive studies usually suggest that capuchins, unlike great apes and humans, neither employ imitation to acquire object manipulation skills nor comprehend cause and effect relationships in object manipulation. Instead, capuchins are thought to rely upon the less cognitively demanding trial-and-error or associative learning; successful tool use can be considered almost fortuitous.

Here I present data from an ongoing field study that are inconsistent with these accepted findings. Brown capuchins (*Cebus apella*) at Raleighvallen Nature Preserve in Suriname exhibit object manipulation abilities in foraging, including object and tool use, exceeding those previously described for wild or captive capuchins. The food items being processed with these exceptional skills are numerous species of morphologically diverse, thickly husked fruits, with fruit walls impenetrable even to the powerful jaws of the brown capuchin. These fruit taxa, many in the Lecythidaceae, the Brazil nut family, are rare in Western Amazonia and Central America, regions in which wild capuchins have been most often studied. Evidently, the abundance, high nutritional quality, and diverse morphology of husked fruits in the Guianas provide the appropriate incentive for development of patently goal-oriented, complex manipulative skills. Our field observations of the capuchins, together with phenological studies of fruit availability at Raleighvallen, indicate that successful learning of processing skills is rapid and focused to a considerable extent at the level of husked fruit species. For each separate species of husked fruit, the instances of intense visual monitoring and the more limited 'practicing' by immature capuchins appears to coincide with the initiation of that species' seasonal availability. After a period of familiarity with a husked fruit species, attentiveness by immatures to others processing that species appears to decline. Imitation cannot yet be excluded as one of the learning mechanisms underlying the acquisition of these manipulative skills.

Computer technology in Anthropology education: A review of multimedia and online software. D.R. BOLTER, Department of Anthropology, Modesto College, Modesto, CA 95350.

The end of the century has seen an increase in the use of computer technology in Anthropology education. What will coursework in Physical Anthropology be like in the new millennium? Three methods of multimedia will be presented here: the use of the CD-Rom in housing digital 3-D skeletal imaging; the application of the multimedia software Toolbook to prepare student-initiated, interactive programs; and the online distance-learning course management system Anlon (IntraKal) for offering Physical Anthropology classes online. An analysis of the strengths and weaknesses of the technologies will be addressed.

A sex-based DNA analysis of 8,500 year old "ancestor" skulls from the Levant. M. BONOGOFSKY, University of California at Berkeley, CA 94720, and R. S. MALHI, Molecular Anthropology Lab, University of California at Davis, CA 95616.

A commonly held belief states that the skulls of important male elders were plastered and painted as part of an ancestor cult during the Pre-Pottery Neolithic B period in the Levant. The first such plastered skulls were found by Kathleen Kenyon at Jericho in 1953. Kenyon initially viewed them as portrait skulls of venerated ancestors. They were thought to have been those of male tribal or family elders, even though an osteological basis for this interpretation was lacking. A similar line of thought regarding the age and sex of these plastered skulls continued as more specimens were discovered in Syria, Israel and Jordan, despite conflicting anthropological evidence.

We evaluate the hypothesis that the 8,500 year old decorated skulls belonged to men through the use of a DNA based sex determination technique. PCR analysis of the amelogenin gene (Sullivan 1993) was used on ancient DNA samples, extracted using the Yang protocol (1998), from select cranial samples to determine the sex of these individuals.

The presence of females among the cranial samples will be discussed in terms of an intellectual environment which has overlooked the role of women and children in Pre-Pottery Neolithic society.

Supported by awards from the Council of American Overseas Research Centers, Stahl Endowment, Center for Middle Eastern Studies/Mellon Foundation, and NIH Grants RR00169 and RR05090.

Can giving birth show up in tooth development? J.E. BOWMAN, Anthropology, University of Pennsylvania, Philadelphia, PA 19104.

It is well established that the period of transition from intra-uterine to extra-uterine environment will often coincide with the formation of a defective zone in tooth enamel and dentine known as the neonatal line. This presentation examines the suggestion made by Boyde in 1990 that parturition may also show up as a 'setback' in hard tissue development in primate teeth.

The timespan of dental development of a series of Old and New World primate species is presented and discussed in relation to the reproductive years of the females. On the basis of this information it is possible to establish which teeth are still forming when they give birth to their offspring. The most likely locations of defects on tooth crowns and roots that may be related to parturition are identified for each species. In addition, evidence of defective dentine in a maxillary third molar of a female rhesus monkey is described and it is suggested that this represents a 'parturition-related defect' in the dental tissues. Hard tissue defects thought to be related to giving birth in some non-primate mammals are also discussed.

The evidence available regarding parturition and dental defects warrants further study using teeth from individuals with known reproductive histories. Furthermore, researchers need to be aware of the likely location of 'parturition-related defects' in their samples in order to correctly identify them. The ultimate aim of this work is to enable the accurate identification of the age of first reproduction in both living and fossil primates from the teeth alone.

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Behavioral variability in ring-tailed lemurs (Lemur catta). A.M. BOYD, Department of Anthropology, East Carolina University, Greenville, NC 27858

It is commonly accepted that anthropoid primates exhibit some degree of behavioral variability based on personality, age, rank, and sex. The goal of this research was to determine if ring-tailed lemurs exhibit similar behavioral variability. Field observations were conducted on a habituated troop of 11 semifree-ranging ring-tailed lemurs housed in a natural habitat enclosure at the Duke University Primate Center. Each lemur has a unique collar and tag that allows for animal identification.

Twenty-minute focal animal sampling (randomized daily) and a standard ethogram for ring-tailed lemurs (i.e., common behavioral categories) were used to record activities. Data were collected on a check-off sheet and the behavior categories were tallied from the sheets. Means for males vs. females, high ranking individuals vs low ranking individuals, and older individuals vs younger individuals were calculated for selected behaviors and compared by t-test. Results suggest that ring-tailed lemurs do not show extensive behavioral variability.

Duke University Primate Center publication #710

Tooth Size Differences and the Antiquity of Cooking. C. L. BRACE, Museum of Anthropology, University of Michigan, Ann Arbor, MI 48109

By the time *Australopithecus africanus* had been superseded by *Homo erectus* between 2.0 and 1.5 Mya, Summary Tooth Size (TS) had reduced from over 2,000 mm^2 to just under 1,600 mm^2. The most likely reason was that *H. erectus* had become a facultative carnivore and included a much larger proportion of meat in the diet than had previously

been the case. Meat requires less chewing and dental reduction was produced by the accumulation of mutations that were not selected against — an example of the consequences of the Probable Mutation Effect. From WT 15000 at 1.6 Mya to the time of the early European Neanderthals at Krapina in Croatia 130 Kya, hominid tooth size remained essentially the same while brain size approximately doubled. Occupation of the 'temperate' zone was made possible for a tropical hominid by the control of fire between 300 and 200 Kya. Its subsequent application to food preparation reduced the level of selection maintaining tooth size. Over the last 100,000 years, human tooth size in some populations underwent another 500mm^2 reduction.

Tooth size in living human populations ranges from fully classic Neanderthal levels of over 1,500 mm^2 down to 400 mm^2 smaller in north temperate zone groups at both the eastern and western ends of the Old World. If this is the result of the further reduction of the forces of selection because of the use of cooking in food preparation since the last interglacial, then the degree of reduction in other populations in the world should be in proportion to the regional antiquity of cooking. The distribution of tooth size levels in living human groups can be shown to agree with the archaeological evidence indicating the approximate date of the adoption of cooking in the areas in question.

Head stabilization in human running: implications for hominid evolution. D. M. BRAMBLE, Department of Biology, University of Utah, Salt Lake City, UT 84112.

The capacity for sustained running distinguishes modern humans from all other primates, yet this fact is almost completely ignored in modern theories on the origin and evolution of *Homo*. This presentation focuses on recent experimental analyses of head stabilization in running humans and their implications for interpreting evolutionary patterns in hominid cranial form and function.

We have combined techniques (kinematic analysis, accelerometry, electromyography) to study the biomechanics of head stabilization during treadmill running at endurance speeds (3-5 m/s) in adults of both sexes. Our findings show that the human head remains remarkably steady despite substantial, repetitive accelerations of the trunk. Angular displacements (i.e., sagittal pitching) are typically less than 10 degrees over the step cycle. Forelimb kinematics and EMG profiles of the trapezii support the idea that the arms play a central role in the stabilizing mechanism by counterbalancing the forward pitching motions of the head-neck complex. The characteristic elevated shoulder position of human runners is reflective of this mechanism.

To assure body balance, effective head stabilization is essential to any running mammal, but especially so in a biped. Multiple features of the human cranium appear to promote head stability during running. These include overall skull proportions as well as details of the occipital and mastoid regions. Based on such features, the capacity for head stabilization appears to have been distinctly inferior in australopithecines compared to *Homo*. The most striking modifications for stabilization are found in *H. erectus* and various "archaic" *H. sapiens*. Decreased adaptation for head stabilization seems to have paralleled a decline in overall skeletal robusticity in the emergence of modern humans. These observations suggest that endurance running may have been a key behavioral innovation associated with the origin and subsequent structural evolution of *Homo*.

Male reproductive ecology: Development and life history. R.G. BRIBIESCAS, Department of Anthropology, Yale University, New Haven, CT 06520-8277

Testosterone levels are consistently lower in non-western males compared to western controls. For example, Ache men of Paraguay exhibit significantly lower salivary testosterone (Tsal) levels compared to Boston men (Bribiescas 1996). However the mechanism behind population variation in male reproductive endocrine function is unclear. An analysis of additional Tsal levels from other Ache communities as well as a review of literature data on the effects of developmental factors on gonadotropin production are presented in an attempt to explain this observation. Ache data and results from the clinical literature suggest that developmental factors associated with decreased Leydig cell sensitivity are likely although compromised gonadotropin secretion cannot be excluded. It is suggested that (1) only the most extreme energetic demands will suppress male reproductive function; (2) chronic energetic deficits during adolescent development may underlie in lower steroid hormone profiles during adulthood; (3) decreases in male reproductive function in response to negative energy balance does not result in significant decreases in male fecundity; and (4) changes in testosterone levels in response to chronic or acute negative energy balance reflects a trade off between somatic investment in reproductive effort and survivability.

The Development of a 'Standard' for Measuring Bone Mineral Density in Archaeological Bone. M.Brickley, Dept. of Ancient History & Archaeology, University of Birmingham, Birmingham B15 2TT, England.

Age-related bone loss and osteoporosis currently represent a major health problem, both economically and socially, in many areas of the world. An awareness of the problems caused by fractures related to the condition has prompted the investigation of bone loss and osteoporosis in archaeological bone.

A number of studies have now been undertaken, using a variety of techniques, and interesting results have been obtained. However, due to a lack of standardisation results from these studies cannot be directly compared. Comparability between results is essential in order that a better understanding of possible temporal, spatial, or culturally related differences in bone loss between 'populations' can be gained.

A simple 'standard' is being developed for use when measuring age-related bone loss and osteoporosis in archaeological bone. It is recognised that not all researches will have access to the same equipment, so it will be possible to use the 'standard' with various techniques. 'Standards' contain cubes of resin of varying densities, so results obtained from archaeological bone can be calibrated. Five identical 'standards' are being constructed and will be housed at Birmingham University. 'Standards' will be available on loan, free of charge, to anyone who wishes to conduct a study.

With time, the accumulation of data from studies that employ this technique will form an invaluable resource. A fuller understanding of any variations in levels of age related bone loss and osteoporosis in past populations would be of considerable value to both paleopathologists and those studying the condition in the present population.

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The endocast of Poloyo 1 (PL-1), a new *Homo erectus* from Java
D.C. BROADFIELD[1,2], R.L. HOLLOWAY[2,4], S. MARQUEZ[1,2], J.T. LAITMAN[1,2], T. JACOB[5], and K. MOWBRAY[3], Department of Cell Biology and Anatomy, Mount Sinai School of Medicine[1], NY, NY 10029, NYCEP[2], Rutgers University[3], New Brunswick, NJ 08903, Columbia University[4], NY, NY 10027, Gadjah Mada University[5], Yogyakarta, Indonesia.

The taxon *Homo erectus* occupies a considerable timeframe in hominid evolution. Accordingly, variations or changes in their paleoneurology may be of great value in interpreting brain evolution. Indonesian *H. erectus* is characterized by a long, low cranial vault, sloping forehead, and angled occipital region. These features are reflected on the endocasts, which range in size from 813cc to 1059cc. While we can witness the increase in brain volume in *H. erectus* over the course of a million years or more, there has been little evidence of the development of modern *Homo*-like traits in their endocasts. The endocast of a new calvaria discovered near Poloyo, Java, however, offers evidence suggesting the appearance of more modern characteristics in *H. erectus*.

A rhodorsil silicon rubber endocast was made from the Poloyo calvaria (PL-1), and the base of the endocast was reconstructed so that an accurate endocranial volume could be obtained. Initial measurements yield a cranial capacity of approximately 900cc. The frontal lobe offers a more shortened, rounded appearance in contrast to the flat, elongated appearance of other Indonesian fossils (e.g., Sangiran 17). In addition, there appears to be a greater degree of asymmetry in the endocast characterized by a strong left-occipital, right-frontal petalial pattern, and significant asymmetry in Broca's cap. Also, the widest position on PL-1 is superior to that exhibited in other *H. erectus*.

While diminutive in cranial capacity, PL-1 exhibits a paleoneuroanatomy not present in other Indonesian *H. erectus*. This fossil represents an exciting addition to our current understanding of human evolution in Indonesia, and promises to offer new insights into hominid brain evolution.

This research is supported under NSF grant SBR9528100.

Birth Season Cortisol Levels in Dispersing Male *Propithecus verreauxi*. D.K BROCKMAN[1], P.L WHITTEN[2,3], and A.F. RICHARD[4], [1]Department of Biological Anthropology & Anatomy, Duke University, Durham, NC 27708, [2]Department of Anthropology, Emory University, Atlanta, GA 30322, [3]Department of Biology, Emory University, Atlanta, GA 30322, [4]Provost and Department of Anthropology, Yale University, New Haven, CT 06520.

Like many other social mammals, male sifaka are the dispersing sex, most often leaving their natal group at three years of age, although some 7-8 year old males have yet to disperse from their natal group. Males exhibit both age-specific and individual differences in inter-group transfer rates, with younger males migrating 2-3 times more frequently between groups than older males. Recent demographic data indicate that approximately 35% of adult males migrate annually and that a third of migrations occur during the birth season, with the result that as many as 60% of groups undergo a change in male membership at this time. These changes invariably alter group stability and threaten male status and, occasionally, reduce infant survivorship through male infanticide. In this study we examined the relation of male dispersal and social status to the patterning of birth season aggression and fecal cortisol (fC) levels in sifaka at Beza Mahafaly Special Reserve (BMSR).

Behavioral and hormonal data were collected on 38 adult males during the June-August 1998 birth season. Our weekly census of 30 sifaka social groups identified 15 males residing in 8 stable groups and 23 adult males living in 8 unstable groups, yielding 210 fecal samples and 493 focal animal hours of observation. The results suggest that birth season elevations in fC are less responsive to residence status, rank, and aggression *per se* than they are the consequence of social disruption resulting from male movements between groups and the particular responses of individual males to dispersal events. Hormonal responses often follow immigration events and occasionally register reactions not evident in the behavioral response. Reactions occurred primarily in subordinate males and in some alpha males following the birth of

infants, suggesting that resident males differ in their responses to group destabilizing influences, perhaps due to different reproductive opportunities and/or investment.
This research was supported by grants from the Duke University Arts and Sciences Research Council and The Margot Marsh Biodiversity Foundation.

Elevated sleep blood pressure in working women from high risk ethnic groups: Japanese-American school teachers in Hawaii. D. E. BROWN, S. L. AKI, P.S. MILLS, M. B. ETRATA, R. KOHAGURA, K. SMART, Anthropology, University of Hawaii at Hilo, Hilo, HI 96720, and G. D. JAMES, Nursing, Binghamton University, NY 13902.

Japanese-Americans (JAs) have high prevalence rates of hypertension compared with Caucasians (Cs) and state of Hawaii averages, and also have high mortality rates from strokes. Ambulatory blood pressure (BP) recordings were taken on female teachers of JA (N=79) or C (N=41) ethnicity working in public schools located in Hilo, Hawaii. BP was measured at 15 min intervals during waking hours and 30 min intervals during sleep over a 24 hr period that included a full work day. These measurements were averaged during three daily settings: at work, at home while awake, and during sleep. There are no significant ethnic differences in mean systolic or diastolic BP in the work or home settings, but JAs have signficantly higher mean systolic ($t=2.3$, $p < 0.05$) and diastolic ($t=3.5$, $p < 0.001$) BP during sleep. When age and body mass index (BMI) are controlled in analyses of covariance, significant main effects from ethnicity are found for mean sleeping systolic ($F=7.2$, $p < 0.01$) and diastolic ($F=13.0$, $p < 0.001$) BP. These results are similar to those found in previous studies that compared Filipino-Americans with Cs in Hawaii, and African-Americans with Cs in New York City, with the non-Caucasian groups identified as having higher risk for hypertension and strokes. In both comparisons, BP means during sleep, but not during waking hours, were significantly different between the ethnic groups. Maintenance of high BP during sleep may be a specific identifier of people from high risk ethnic groups.

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Patterns of osteon size, comparing Holocene hunter-gatherers and recent humans. M. D. BROWN. Dept. of Human Biology and Nutritional Sciences, University of Guelph, Guelph, Ontario, Canada N1G 2W1.

This quantification of cortical osteon (On.Ar) and Haversian canal areas (H.Ar) in Later Stone Age (LSA) populations (ancestral Khoisan), provides a link between recent and Late Pleistocene humans where smaller osteon sizes have been previously noted. Rib (9F,7M) and midshaft femur (7F,2M) sections, from several archaeological sites in South Africa, C^{14} dated from 600 to 10,000 YBP, were measured for On.Ar and H.Ar. As many structures were measured as possible to reduce intra-individual variability, resulting in unequal replicates of 41 to 114 pairs of measurements per section. These data were compared to a sample of Huguenots (18^{th} C) from Spitalfields, England (Recent)(rib: 29F, 24M; femur: 9F,11M) and statistically analyzed using a 2-factor ANOVA. Rib On.Ar comparisons demonstrate no significant overall or sex differences between LSA and Recent. Rib H.Ar comparisons are not significantly different except that LSA males are significantly larger than Recent males and females. Femoral comparisons demonstrate significantly smaller LSA On.Ar and H.Ar than Recent. The differential pattern between the rib to femur area ratios of the LSA sample indicates a local modulation of remodeling. These results provide evidence for biomechanically-induced remodeling, manifesting its effect as smaller osteon and Haversian canal areas in LSA humans. A possible mechanism for these results can be provided through the positive correlations between physical exercise and transforming growth factor-β which acts to inhibit osteoclastic action and promote osteoblastic formation.

This research is supported by the Social Science and Humanities Research Council of Canada.

Exercise performance and menstrual cycle phase in high altitude native women at 3,600 m. T. D. BRUTSAERT, State University of New York at Albany, Dept. of Anthropology. H. SPIELVOGEL, E. CACERES, and M. ARAOZ, Instituto Boliviano de Biología de Altura, La Paz, Bolivia. R. CHATTERTON, Northwestern University, Chicago, IL. V. J. VITZTHUM, State University of New York, Binghamton, Dept. of Anthropology.

It is well established that normally menstruating women at sea level show an increase in ventilation, cardiac output, and plasma volume during the mid-luteal (L) phase of the menstrual cycle compared to the follicular (F) phase. The increase in ventilation is particularly well understood, and is due to the actions of progesterone and estrogen on the carotid body and central nervous system. It has been hypothesized that an increase in ventilation during the L-phase may be important at high altitude where alveolar ventilation serves to maintain arterial oxygen saturation. In the present study we report on the exercise performance of healthy Bolivian women tested at high altitude (3,600 m) in a self paired, randomized study during both their F and L-phases. Women subjects in the study (up to 35 yrs. age) were non-pregnant and non-lactating for a minimum of 6 months prior to the study and reported regular menstrual cycles of 25-35 days duration. Menstrual cycle phase was determined by salivary progesterone assay. Two groups of women were studied in both F and L-phases: (1) urban women (n=30) of middle socio-economic status and mixed European and Native Aymara ancestry, and (2) peri-urban women (n=25) of lower socioeconomic status and of primarily Aymara ancestry. Oxygen consumption (VO_2)

measurements were made during submaximal and maximal exercise on a cycle ergometer using a Douglas bag method. In both groups of women, pulmonary ventilation (V_E) and ventilatory equivalent (V_E/VO_2) were higher at all work loads (including maximal work) in the L versus F-phase. However, as with similar studies that have been conducted at sea level, no differences were detected in maximal work output, maximal oxygen consumption, maximal heart rate, or respiratory exchange ratio in the L vs. F-phase. Thus, results suggest no effect of menstrual cycle phase on the physical working capacity of highland native women tested at high altitude.

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Brain size ontogeny and evolution in *Papio*. L.S. Buchanan, Department of Anthropology, University of Illinois, Urbana.

This analysis investigates cranial capacity evolution and ontogeny in the genus *Papio*. Brain size evolution and ontogeny are best understood by utilizing a comparative approach, incorporating data from extant papionins and from the fossil record. Such data have important implications for both ecology and life history patterns.

Cranial capacities and dental eruption schedules were recorded for 116 specimens representing 6 subspecies of the genus *Papio*. Aging standards based on captive populations are utilized to estimate chronological ages. A comparative sample of other papionins is utilized to evaluate brain size ontogeny in *Papio*. Limited fossil data representing *Papio angusticeps* and P. *izodi* are also evaluated. Data from extant *Papio* are used to develop cranial capacity prediction equations from external neurocranial distances for the fossil data.

Relative to other papionins, the ontogeny of brain size in extant *Papio* is characterized by increased brain growth at early stages of development. Fossil data indicate a significant increase in absolute brain size in the recent evolution of *Papio*. Whether a relative brain size increase has occurred is problematic. Other papionins appear to retain a brain size and pattern of brain growth that is ancestral for *Papio*. The derived pattern of increased early growth rate appears to be responsible for brain enlargement in modern *Papio*.

Papio appears to employ a life history strategy that involves high maternal investment in offspring during early ontogeny. This may be related to the importance of foraging success in young baboons. Without fossil data the divergence of *Papio* looks like a brain driven event. However, combining fossil data with ontogenetic data indicates that the divergence likely involved derived changes in growth or size.

This research was supported by NSF (SBR 9707361) to S.R. Leigh and the University of Illinois.

Subadult Skeletal Pathology on Prehistoric Tongatapu, Polynesia. H. R. BUCKLEY, University of Otago, Dunedin, New Zealand.

This paper focuses on the differential diagnosis of pathological lesions recorded on the limbs and crania of seventeen subadults from two pre-European burial mounds in Tonga, western Polynesia. The recorded pathology consists primarily of subperiosteal new bone deposition on the limbs and endocranial surfaces. The presence of cribra orbitalia in a number of individuals indicate concurrent iron-deficiency anaemia. At Mound1, 10 of the 24 (41%) subadults have pathology of some sort, and at Mound 2, seven of the 10 (50%) subadults have pathology. All affected subadults are between the ages of six months and three years at death. A differential diagnosis of haematogenous osteomyelitis, congenital syphilis, yaws, scurvy, hypervitaminosis A, trauma, Caffey's disease, and iron-deficiency anaemia is discussed. It is concluded that the most likely cause for the lesions observed is a synergistic relationship between infection (weanling diarrhoea, yaws) and metabolic disease (scurvy and hypervitaminosis A). Trauma is not ruled out as contributing to the development of some pathological lesions. It is concluded that, in the the Pacific Islands, multiple causes for skeletal pathology in subadults should be considered rather than a single aetiology.

Evaluating the Risk of Recent Pregnancy on Death by Tuberculosis in Gibraltar, 1874-1884. S.D.A. BURKE and L.A. SAWCHUK University of Toronto at Scarborough, Scarborough, Ontario, Canada M1C 1A4

Historical population-level research on patterns on pulmonary tuberculosis mortality suggests that males and females experienced distinct timings in peak mortality from this disease. While both males and females may have acquired the disease in childhood, females were prone to a more rapid onset in their young adult years while among males the disease was more typically manifested in late adulthood. Several explanations have been offered to account for this gender difference, including possible burdens which pregnancy represented

to the development of tubercular illness among females. While some propose that the biological stresses of pregnancy, and particularly confinement, increase the risk of disease reactivation, others suggest that the causal association could be explained by increased post-partum economic burdens. This research is based on a cohort of 254 women who died during their reproductive years in Gibraltar between 1874-1884. Of the total deaths, 54.7% resulted from pulmonary tuberculosis. Family reconstitution techniques allowed for the determination of the date of each woman's last-born child prior to her death. Logistic regression analyses suggest that women in the 20-24 age group (OR 3.2), women who were members of the Roman Catholic community (OR 3.1), and women who were widows (OR 7.5) at the time of their death displayed increased odds of dying from tuberculosis. Neither a birth within 1 year prior to death, nor a birth within 2 years prior to death were significant predictors of tuberculosis mortality. This research, therefore, does not support the hypothesis that pregnancy impacts on the etiology of death by tuberculosis.

Variation in the human lateral femoral circumflex artery. A.M. BURROWS and D.R. KEELOR, School of Physical Therapy, Slippery Rock University, Slippery Rock, PA 16057.

Variations in the vascular structures of the human lower limb are numerous, yet frequencies and specific variation patterns are debated. This study focuses on the lateral femoral circumflex artery which has been cited as being among the most variable arteries of the lower limb. The lower limbs of 22 adult human cadavers (44 total lower limbs) were dissected so that the entire distribution of the vessel and its branches was revealed. Each artery was examined and scored for source and branching pattern.

The classic origin of the lateral femoral circumflex artery is from the medial aspect of the deep femoral artery, passing deep to the sartorius and rectus femoris muscles where it then divides into ascending, transverse, and descending branches. Two different origin patterns of the lateral femoral circumflex artery were observed in the present study. Most commonly (88.4%), the origin was from the deep femoral artery while it originated from the femoral artery more rarely (11.6%). However, the branching pattern of the lateral femoral circumflex was quite varied with a total of five different branching patterns observed. The most frequently observed branching pattern was one small ascending branch, one small transverse branch, and three larger, distinct descending branches (65%). This pattern is in contrast to the usually cited single branch of each. While the transverse branch has been cited as being often absent, in this study it was found in all limbs. The ascending branch was absent in two (4.7%) lower limbs. The same origin and branching patterns were seen bilaterally in all but six of the cadavers (73%).

These results on variation in the human lateral femoral circumflex artery and its branches conflict with previous studies on frequencies of specific branching patterns. This discrepancy may reflect population differences or method of observation.

Health and disease in 19th century San Francisco: skeletal evidence from a forgotten cemetery. M.R. BUZON, P.L. WALKER, F. DRAYER, S. KERR, Department of Anthropology, University of California, Santa Barbara, CA 93106.

During the 1994 renovation of San Francisco's California Palace of the Legion of Honor, more than 900 hundred burials were discovered, in an area formerly occupied by the Golden Gate Cemetery. Archaeological evidence and historical records suggest that these individuals were interred between 1868 and about 1906. Artifactual and skeletal evidence indicates that most of the burials are those of poor, working-class people of European ancestry. However, people of other ethnicities (Chinese and perhaps Native American) were also buried in the cemetery and the associations of some of the burials suggest access to considerable wealth. Some of the material recovered from the cemetery consists of amputated body parts, fetuses, preserved medical specimens, other remains that appear to be hospital waste.

Access to this material for osteological analysis was limited to a few days immediately prior to its reburial. As a result, we were only able to study a small fraction of the total sample and we were forced to limit our analysis to comparatively complete, well-preserved, non-commingled skeletons. To maximize the amount of information we obtained, we used an abbreviated version of the *Standards for Data Collection from Human Skeletal Remains* for recording age, sex, metrical observations and pathological conditions.

Of the 91 individuals examined, 9 were subadults and 82 adults were included in this sample. These individuals show various traumatic injuries, such as gunshot wounds and fractures. Examination of the observable dentition indicates that 37% (20/53) have enamel hypoplasia, 42%(34/80) have at least one carious lesion, and 36% (29/81) at least one abscess. Porotic hyperostosis was present in only 2% (2/74) of the individuals, cribra orbitalia was present in 8% (6/71). Periosteal reaction on the tibia occurred in 19% (14/75). Comparisons between these results and other 19th century American sites suggests that these individuals were subjected to stressors similar to those found in other lower class populations.